

WHAT IS CLAIMED IS:

1 1. A microstructure for steering light, the microstructure comprising:
2 a substrate;
3 a structural linkage connected with the substrate and supporting a structural
4 film, the structural film including a reflective coating; and
5 a first hold electrode connected with the substrate at a position laterally
6 beyond an orthogonal projection of the structural film on the substrate and configured to hold
7 the structural film electrostatically in a first tilted position with respect to the substrate upon
8 application of a potential difference between the structural film and the first hold electrode.

1 2. The microstructure recited in claim 1 further comprising a first snap-in
2 electrode connected with the substrate at a position laterally within the orthogonal projection
3 of the structural film on the substrate and configured to tilt an end of the structural film in a
4 direction towards the first snap-in electrode upon application of a potential difference
5 between the structural film and the first snap-in electrode.

1 3. The microstructure recited in claim 2 wherein the first snap-in
2 electrode comprises a polysilicon layer.

1 4. The microstructure recited in claim 3 wherein the first hold electrode
2 comprises a polysilicon bilayer.

1 5. The microstructure recited in claim 1 wherein the reflective coating
2 comprises gold.

1 6. The microstructure recited in claim 1 wherein the first hold electrode
2 comprises a comb structure having a plurality of teeth, the first hold electrode being
3 configured such that the first tilted position is defined by an angle with respect to the
4 substrate that depends on the potential difference between the structural film and the first
5 hold electrode.

1 7. The microstructure recited in claim 6 wherein the angle of the first
2 tilted position deviates increasingly from horizontal with an increase in the potential
3 difference between the structural film and the first electrode.

1 8. The microstructure recited in claim 1 further comprising a second hold
2 electrode connected with the substrate at a position laterally beyond an orthogonal projection
3 of the structural film and the substrate and on an opposite side of the structural linkage from
4 the first hold electrode, wherein the second hold electrode is configured to hold the structural
5 film electrostatically in a second tilted position with respect to the substrate upon application
6 of a potential difference between the structural film and the second hold electrode.

1 9. The microstructure recited in claim 8 further comprising first and
2 second snap-in electrodes connected with the substrate at positions laterally within the
3 orthogonal projection of the structural film on the substrate and on opposite sides of the
4 structural linkage, each of the first and second snap-in electrodes being configured to tilt an
5 end of the structural film in a direction towards that snap-in electrode upon application of a
6 potential difference between the structural film and that snap-in electrode.

1 10. The microstructure recited in claim 9 wherein the first and second
2 snap-in electrodes comprise a polysilicon layer.

1 11. The microstructure recited in claim 10 wherein the first and second
2 hold electrodes comprise a polysilicon bilayer.

1 12. The microstructure recited in claim 8 wherein the reflective coating
2 comprises gold.

1 13. The microstructure recited in claim 8,
2 wherein the first hold electrode comprises a first comb structure having a
3 plurality of teeth, the first hold electrode being configured such that the first tilted position is
4 defined by a first angle with respect to the substrate that depends on the potential difference
5 between the structural film and the first electrode; and
6 wherein the second hold electrode comprises a second comb structure having a
7 plurality of teeth, the second hold electrode being configured such that the second tilted
8 position is defined by a second angle with respect to the substrate that depends on the
9 potential difference between the structural film and the second electrode.

1 14. The microstructure recited in claim 13,

2 wherein the first angle deviates increasingly from horizontal with an increase
3 in the potential difference between the structural film and the first electrode; and

4 wherein the second angle deviates increasingly from horizontal with an
5 increase in the potential difference between the structural film and the second electrode.

1 15. A method for fabricating a microstructure for steering light, the
2 method comprising:

3 forming a first hold electrode on a substrate;

4 forming a structural linkage on the substrate;

5 forming a structural film on the structural linkage; and

6 depositing a reflective coating on the structural film;

7 wherein the first hold electrode is at a position laterally beyond an orthogonal
8 projection of the structural film on the substrate and configured to hold the structural film
9 electrostatically in a first tilted position with respect to the substrate upon application of a
10 potential difference between the structural film and the first hold electrode.

1 16. The method recited in claim 15 further comprising forming a first
2 snap-in electrode on the substrate at a position laterally within the orthogonal projection of
3 the structural film and the substrate and configured to tilt an end of the structural film in a
4 direction towards the first snap-in electrode upon application of a potential difference
5 between the structural film and the first snap-in electrode.

1 17. The method recited in claim 15 wherein the reflective coating
2 comprises gold.

1 18. The method recited in claim 15 wherein forming a first hold electrode
2 comprises forming a comb structure having a plurality of teeth, wherein the first hold
3 electrode is configured such that the first tilted position is defined by an angle with respect to
4 the substrate that depends on the potential difference between the structural film and the first
5 hold electrode.

1 19. The method recited in claim 15 further comprising forming a second
2 hold electrode on the substrate at a position laterally beyond an orthogonal projection of the
3 structural film on the substrate and on an opposite side of the structural linkage from the first
4 hold electrode, wherein the second hold electrode is configured to hold the structural film

5 electrostatically in a second tilted position with respect to the substrate upon application of a
6 potential difference between the structural film and the second hold electrode.

1 20. The method recited in claim 19 further comprising forming first and
2 second snap-in electrodes on the substrate at positions laterally within the orthogonal
3 projection of the structural film on the substrate and on opposite sides of the structural
4 linkage, each of the first and second snap-in electrodes being configured to tilt an end of the
5 structural film in a direction towards that snap-in electrode upon application of a potential
6 difference between the structural film and that snap-in electrode.

1 21. The method recited in claim 19 wherein the reflective coating
2 comprises gold.

1 22. The method recited in claim 19 wherein,
2 forming a first hold electrode comprises forming a first comb structure having
3 a plurality of teeth, wherein the first hold electrode is configured such that the first tilted
4 position is defined by an angle with respect to the substrate that depends on the potential
5 difference between the structural film and the first hold electrode; and
6 forming a second hold electrode comprises forming a second comb structure
7 having a plurality of teeth, wherein the second hold electrode is configured such that the
8 second tilted position is defined by an angle with respect to the substrate that depends on the
9 potential difference between the structural film and the second hold electrode.

1 23. A method for operating an optical switch, the method comprising:
2 tilting a first end of a micromirror assembly towards a substrate by applying a
3 first electrostatic force; and

4 thereafter, holding the micromirror assembly in a first tilted position with
5 respect to the substrate with a second electrostatic force originating from a point laterally
6 beyond an orthogonal projection of the micromirror assembly on the substrate.

1 24. The method recited in claim 23 further comprising:
2 releasing the micromirror assembly from the first tilted position;
3 thereafter, tilting a second end of the micromirror assembly towards the
4 substrate by applying a third electrostatic force; and

5 thereafter, holding the micromirror assembly in a second tilted position with
6 respect to the substrate with a fourth electrostatic force originating from a point laterally
7 beyond the orthogonal projection of the micromirror assembly on the substrate.

1 25. The method recited in claim 24 further comprising:
2 selecting the first tilted position from a plurality of possible first tilted
3 positions by establishing a potential difference between the micromirror assembly and a first
4 electrode used to establish the second electrostatic force; and
5 selecting the second tilted position from a plurality of possible second tilted
6 positions by establishing a potential difference between the micromirror assembly and a
7 second electrode used to establish the fourth electrostatic force.

1 26. The method recited in claim 23 further comprising selecting the first
2 tilted position from a plurality of possible first tilted positions by establishing a potential
3 difference between the micromirror assembly and a first electrode used to establish the
4 second electrostatic force.

1 27. A microstructure for steering light, the microstructure comprising:
2 support means;
3 tiltable micromirror means connected with the support means; and
4 first electrostatic-field-generation means for providing an electrostatic field to
5 hold the tiltable micromirror means in a tilted position with respect to the support means,
6 wherein the first electrostatic-field-generation means is connected with the support means at a
7 position laterally beyond an orthogonal projection of the tiltable micromirror means on the
8 support means.

1 28. The microstructure recited in claim 27 further comprising second
2 electrostatic-force-generation means for tilting the tiltable micromirror means, wherein the
3 second electrostatic-field-generation means is connected with the support means at a position
4 laterally within the orthogonal projection of the tiltable micromirror means on the support
5 means.

1 29. The microstructure recited in claim 27 wherein the first electrostatic-
2 force-generation means is configured for providing a plurality of electrostatic fields to hold
3 the tiltable micromirror means in a respective plurality of tilted positions depending on a state
4 of the first electrostatic-force-generation means.

1 30. The microstructure recited in claim 27 wherein the tiltable micromirror
2 means comprises torsion-beam means.

1 31. The microstructure recited in claim 27 wherein the tiltable micromirror
2 means comprises cantilever means.

1 32. A wavelength router for receiving, at an input port, light having a
2 plurality of spectral bands and directing subsets of the spectral bands to respective ones of a
3 plurality of output ports, the wavelength router comprising:

4 a free-space optical train disposed between the input ports and the output ports
5 providing optical paths for routing the spectral bands, the optical train including a dispersive
6 element disposed to intercept light traveling from the input port; and

7 a routing mechanism having at least one dynamically configurable routing
8 element to direct a given spectral band to different output ports depending on a state of the
9 dynamically configurable routing element, wherein the dynamically configurable routing
10 element includes:

11 a micromirror assembly connected with a substrate by a structural
12 linkage; and

13 a first hold electrode connected with the substrate at a position laterally
14 beyond an orthogonal projection of the micromirror assembly on the substrate and configured
15 to hold the micromirror assembly electrostatically in a first tilted position with respect to the
16 substrate upon application of a potential difference between the micromirror assembly and
17 the first hold electrode.

1 33. The wavelength router recited in claim 32 wherein the dynamically
2 configurable routing element further includes a first snap-in electrode connected with the
3 substrate at a position laterally within the orthogonal projection of the micromirror assembly
4 and configured to tilt a first end of the micromirror assembly towards the substrate upon
5 application of a potential difference between the micromirror assembly and the first snap-in
6 electrode.

1 34. The wavelength router recited in claim 33 wherein the dynamically
2 configurable routing element further comprises:

3 a second hold electrode connected with the substrate at a position laterally
4 beyond the orthogonal projection of the micromirror assembly on the substrate and on an

5 opposite side of the structural linkage, wherein the second hold electrode is configured to
6 hold the micromirror assembly electrostatically in a second tilted position with respect to the
7 substrate upon application of a potential difference between the micromirror assembly and
8 the second hold electrode; and

9 a second snap-in electrode connected with the substrate at a position laterally
10 within the orthogonal projection of the micromirror assembly and on an opposite side of the
11 structural linkage, wherein the second snap-in electrode is configured to tilt a second end of
12 the micromirror assembly towards the substrate upon application of a potential difference
13 between the micromirror assembly and the second snap-in electrode.

1 35. The wavelength router recited in claim 32 wherein the first hold
2 electrode comprises a comb structure having a plurality of teeth, the first hold electrode being
3 configured such that the first tilted position is defined by an angle with respect to the
4 substrate that depends on the potential difference between the micromirror assembly and the
5 first hold electrode.